

12. The process of claim 3 wherein a first mid-location catalytic stage receives the effluent from the last thermal or oxidation stage, a second mid-location catalytic stage receives the effluent from the first mid-location catalytic stage, the first and second mid-location catalytic stages each have a single catalyst bed containing only selective oxidation catalyst.

a4 13. The process of claim 12 wherein a third mid-location catalytic stage receives effluent from the second mid-location catalytic stage and has a single catalyst bed containing only Claus reaction catalyst.

14. The process of claim 13 wherein a tail gas stage receives effluent from the third mid-location catalytic stage and produces an effluent with less than one mole percent non-elemental sulfur components.

15. The process of claim 3 wherein one or more of the mid-location catalytic stages of step (b) comprise an other catalytic bed containing only Claus reaction catalyst, hydrogenation catalyst or sulfur dioxide reduction catalyst.

as 18. The process of claim 17 wherein the gas stream fed to the catalytic stage further comprises a reduction gas of hydrogen, carbon monoxide or hydrogen sulfide.

a6 23. The process of claim 1 wherein capacity expansion from an original design capacity for the unit for sulfur recovery unit is about from 25 percent to about 45 percent.

24. The process of claim 1 wherein capacity expansion from an original design capacity for the unit for sulfur recovery unit is about from 70 percent to about 100 percent.

REMARKS

An enclosed Information Disclosure Statement contains the items required in the last office action Items (a)(i) to (a)(iii). An enclosed Declaration shows the inventor's address above his signature.

Claims 4, 8, 21 and 22 are canceled from the application and are withdrawn from consideration. Claims 23 and 24 depend respectively from claims 1 and 2 and replace the claimed subject matter of canceled claims 21 and 22. Claims 1-3, 7, 9, 12-15, and 18 are amended to meet the requirements of the claim objections and claim rejections under 35 USC 112.

Claims 1-3, 7, 9, 12-15, and 18 are also amended to more clearly avoid the teachings of Kwong, a patent owned by the present assignee of the present application and filed before the issue date of Kwong. The last office action requested the location of the "mid-location". Claims 1-3 now make that clearer. Mid-location catalytic stages are between the thermal stage(s) and the tail gas unit. Kwong described a well known tail gas treatment using selective oxidation catalyst for tail gas streams with less than five mole percent hydrogen sulfide. As extensively reviewed in the description of the prior art in this application, tail gas treatment with selective oxidation catalyst is well known.

The present application does not attempt to claim that prior art. Kwong does not teach any benefit in moving selective oxidation catalyst upstream of the tail gas unit. No reference teaches such a process. The ability to obtain the invention capacity expansion has been available to skilled person in this art for many years. No one has suggested the invention process for selective oxidation catalyst at mid-location catalytic stages.

Further, claims 1 and 2 specifically require removing Claus reaction catalyst from an existing sulfur recovery unit to replace it with selective oxidation catalyst. There is certainly nothing in the prior art to invite such a change. Claus reaction catalyst and selective oxidation catalyst are well known in the art and described as commercially easily available through UOP Corporation. Their formulations, despite being proprietary, cannot bar the present invention.

The present inventor has found a potential for dramatic capacity expansion through use of selective oxidation catalyst in mid-location catalytic stages. Kwong is directed to use of an entirely different reaction at mid-location catalytic stages. Kwong could not have predicted the unexpected advantage of the present invention.

Kwong cannot anticipate the present claims as not disclosing the claimed catalyst in the mid-location stages.

In re Dembiczak, 175 F.3d 994, 1000, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999) ("[P]articular factual findings regarding the suggestion, teaching, or motivation to combine serve a number of important purposes") and "Evidence of a suggestion, teaching, or motivation to combine prior art references may flow, inter alia, from the references

themselves, the knowledge of one of ordinary skill in the art, or from the nature of the problem to be solved."

"[T]he notion ... that combination claims can be declared invalid merely upon finding similar elements in separate prior patents would necessarily destroy virtually all patents and cannot be the law under statute, §103." Panduit Corp. v. Dennison Mfg. Co., 810 F.2d 1561, 1575 (Fed. Cir. 1987). Panduit, 810 F.2d at 1577, continues "Indeed, that the elements noted by the court lay about in the prior art available for years to all skilled workers, without, as the court found, suggesting anything like the claimed inventions, is itself evidence of nonobviousness."

"Specifically, there were no finding on whether there was a dis-advantage to the prior systems, such that the 'nature of the problem' would have motivated a person of ordinary skill to combine the prior art references." Ruiz v. A.B. Chance Co., 57 U.S.P.Q.2d 1161, 1168 (Fed. Cir. 2001).

Kwong's direction to the skilled person is not to use any catalyst in the mid-locations other than sulfur reduction catalyst or Claus reaction catalyst. The availability of the selective oxidation catalyst was known to Kwong at the time of that invention and yet was never suggested in the invention process. Kwong cannot make the claimed invention obvious.

Consideration of the above amendments and remarks is requested and it is submitted that such amendments and remarks place the application in a condition for allowance for claims 1-7. Applicant requests entry of amendments and allowance of such claims.

Respectfully submitted,

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APPENDIX 1

This Appendix 1 is incorporated in the above amendment made in this application and contains the amended paragraphs of the specification and claims in the form showing stricken material in brackets and new material as underlined.

1. A process for retrofit of a unit for sulfur recovery from one or more [process] acid gases comprising [greater than about one mole percent H₂S where such process gas is or process gases are derived from an effluent of one or more thermal stages processing an acid gas feed comprising H₂S] hydrogen sulfide where [a burner] burners for [the] one or more thermal stages of the sulfur recovery unit are adapted to burn the acid gas with an oxygen containing gas [at] , the oxygen containing gas being limited by operating temperature limits of the thermal stages to contain less than or equal to about 28 mole percent oxygen, the improvement comprising:
 - (a) one or more mid-location catalytic stages between a last thermal stage and a tail gas unit acting sequentially on the effluent of [a] the last thermal stage, the effluent of each mid-location catalytic stage forming [to form] a process gas [from each sequential mid-location catalytic stage], whereby the process gas from a last mid-location catalytic stage forms a tail gas comprising five mole percent or less hydrogen sulfide which is converted to elemental sulfur in the tail gas unit such that an effluent of the tail gas unit is less than about one half mole percent hydrogen sulfide;
 - (b) [causing] replacing at least some Claus reaction catalyst in one or more of the mid-location catalytic stages [to comprise] with a selective oxidation catalyst; and
 - (c) reacting a [feed] process gas [to] within the one or more mid-location catalytic stages comprising selective oxidation catalyst with oxygen wherein [H₂S] hydrogen sulfide is converted to elemental sulfur.
2. A process for retrofit of a unit for sulfur recovery from one or more [process] acid gases comprising [greater than about one mole percent H₂S where such process gas is or process gases are derived from an effluent of one or more thermal stages processing an acid gas feed comprising H₂S] hydrogen sulfide where [a burner] burners for [the] one or more thermal stages of the sulfur recovery unit are adapted to burn the acid gas

with an oxygen containing gas [at] , the oxygen containing gas not being limited by operating temperature limits of the thermal stages to contain less than or equal to about 100 mole percent oxygen, the improvement comprising:

- (a) one or more mid-location catalytic stages between a last thermal stage and a tail gas unit acting sequentially on the effluent of [a] the last thermal stage, the effluent of each mid-location catalytic stage forming [to form] a process gas [from each sequential mid-location catalytic stage], whereby the process gas from a last mid-location catalytic stage forms a tail gas comprising five mole percent or less hydrogen sulfide which is converted to elemental sulfur in the tail gas unit such that an effluent of the tail gas unit is less than about one half mole percent hydrogen sulfide;
- (b) [causing] replacing at least some Claus reaction catalyst in one or more of the mid-location catalytic stages [to comprise] with a selective oxidation catalyst; and
- (c) reacting a [feed] process gas [to] within the one or more mid-location catalytic stages comprising selective oxidation catalyst with oxygen wherein [H₂S] hydrogen sulfide is converted to elemental sulfur.

3. A process for sulfur recovery from one or more [process] acid gases comprising [greater than about one mole percent H₂S] hydrogen sulfide where [such process gas is or process gases are derived from] the acid gases are reacted to form an effluent of one or more thermal or oxidation stages [processing an acid gas feed comprising H₂S], the improvement comprising:

- (a) one or more mid-location catalytic stages between a last thermal stage and a tail gas unit acting sequentially on the effluent of [a] the last thermal stage, the effluent of each mid-location catalytic stage forming [to form] a process gas [from each sequential mid-location catalytic stage], whereby the process gas from a last mid-location catalytic stage forms a tail gas comprising five mole percent or less hydrogen sulfide which is converted to elemental sulfur in the tail gas unit such that an effluent of the tail gas unit is less than about one half mole percent hydrogen sulfide;

- (b) one or more of the mid-location catalytic stages comprising a selective oxidation catalyst; and
- (c) reacting a [feed] process gas [to] within the one or more mid-location catalytic stages comprising selective oxidation catalyst with oxygen wherein [H₂S] hydrogen sulfide is converted to elemental sulfur .
7. The process of claim 3 wherein the degree of [H₂S] hydrogen sulfide conversion to elemental sulfur in step (c) is controlled by limiting the amount of oxygen compared to [H₂S] hydrogen sulfide.
9. The process of claim 3 wherein the mid-location catalytic stages comprise [sequentially] sequential heating means, one or more immediately sequential catalyst beds and a separator / condenser.
10. The process of claim 3 wherein a first mid-location catalytic stage receives the effluent from the last thermal or oxidation stage, the first mid-location catalytic stage has a single catalyst bed containing only selective oxidation catalyst and in the first mid-location catalytic stage or upstream of the first mid-location catalytic stage an oxygen containing gas is mixed with the effluent from the thermal or oxidation stage to provide oxygen for a selective oxidation reaction.
12. The process of claim 3 wherein a first mid-location catalytic stage receives the effluent from the last thermal or oxidation stage, a second mid-location catalytic stage receives the effluent from the first mid-location catalytic stage, the first and second mid-location catalytic stages each have a single catalyst bed containing only selective oxidation catalyst [and in the first and second catalytic stage or upstream of the first and second catalytic stages an oxygen containing gas is mixed with the effluent from the thermal or oxidation stage and the first catalytic stage to provide oxygen for a selective oxidation reaction].
13. The process of claim 12 wherein a third mid-location catalytic stage receives effluent from the second mid-location catalytic stage and has a single catalyst bed containing only Claus reaction catalyst.

14. The process of claim 13 wherein a tail gas stage receives effluent from the third mid-location catalytic stage and produces an effluent with less than one mole percent non-elemental sulfur components.
15. The process of claim 3 wherein one or more of the mid-location catalytic stages of step (b) comprise an other catalytic bed containing only Claus reaction catalyst, hydrogenation catalyst or [SO₂] sulfur dioxide reduction catalyst.
18. The process of claim 17 wherein the gas stream fed to the catalytic stage further comprises a reduction gas of hydrogen, carbon monoxide or [H₂S] hydrogen sulfide.